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ABSTRACT

This paper examines some of the theoretical and practical problems associated with the use of hypertext as a medium for teaching, and explores the positive role that it may be able to play in teaching materials. Hypertext is conventionally described as non-linear, and this aspect of non-linearity is interpreted as endowing it with many attractive features. An alternative perception is that hypertext is a fragmented text form, and hence fundamentally flawed as an expository medium. The conventional rhetoric for hypertext is based on the limited concerns of information retrieval and attempts to subordinate linearity in the text. However, an alternative rhetoric is possible based on the aspect of hypertext which is most likely to aid learning, its malleability. An attempt is made to distinguish between the parts that can be most usefully played by linear and non-linear elements in educational texts and an idea is developed of a more general computer assisted instructional document encompassing linear prose, non-linear hypertext, and other multimedia devices. A learner controlled instructional rhetoric is possible for hypertext based on its malleability, and its use in a supplementary role within the context of a more general document form offers considerable potential for education. (15 references) (Author/DB)

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Programme on Learner Use of Media

The Programme on Learner Use of Media has been established to develop an understanding of students' use of and learning from combinations of educational media (both current and anticipated) in distance education. Our specific aims are:

> To maintain and improve the quality of teaching and learning being carried out through combinations of media in the University.
>
> To ensure that the University maintains an appropriate balance between media with respect to teaching effectiveness, learners' strategies for media use, the logistics of use and relative costs.
>
> To develop a knowledge base to support research and policy making in respect of media use.

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An alternative rhetoric for hypertext [1]

Peter Whalley

Overview

A technology that will revolutionise teaching, a useful tool for education, or 'over hyped and over here'? Discussion concerning the uses and merits of *hypertext* and *hypermedia* has often tended to create more heat than light. The aim of this chapter is to examine some of the theoretical and practical problems associated with the use of hypertext as a medium for teaching, and to explore the positive role that it could play in teaching materials.

Hypertext is conventionally described as *non-linear*, and this aspect of non-linearity is taken to endow it with many attractive features. An alternative perception is that hypertext is a *fragmented* text form, and hence fundamentally flawed as an expository medium. The conventional rhetoric for hypertext is based on the limited concerns of information retrieval, and attempts to subordinate linearity in the text. However an alternative rhetoric is possible based on the aspect of hypertext which is most likely to aid learning, its *malleability*.

An attempt is made to distinguish between the parts that can be most usefully played by linear and non-linear elements in educational texts and the idea is developed of a more general *computer based document* encompassing linear prose, non-linear hypertext and other 'multi-media' devices. A learner centred rhetoric is possible for such documents in which the hypermedia play the role of *animateur* for the distant author.

Technology using education

An important starting point in any consideration of the hypermedia is the recognition that they were not purposefully designed for education. The principal foci of this technological drive have been the efficient retrieval of information and entertainment. These aspects of hypermedia are not necessarily antithetic to the goals of education, but equally they do not

[1] The ideas in this chapter were first presented at a meeting of the EARLI "Text Processing" Special Interest Group, University of Amsterdam, November 8-9, 1990.

represent the primary aim of most educational texts. The general history of the use of new technologies in education has tended to reflect the search for panaceas rather than a serious attempt to solve problems. In a more general context, Ravetz (1971) describes how 'technical' problems can become confused with 'practical' problems. Technical problems always have a practical solution, but all practical problems do not necessarily have to have a technical solution. Because the creation of educational materials involves practical as well as conceptual issues, its problems can be mistakenly perceived as being of technological origin, and thus susceptible to a technical 'fix'.

What is it?

One of the great strengths of hypertext, but also a potential source of weakness, is that it is essentially a formless medium. It is quite possible to reinvent the scroll, book, frame-based CAL, and even the video recorder within hypertext systems. Whether this is a wise use of resources will depend on the user's goals, and to some extent on technological developments in terms of cost and the improved ergonomics of display-screen technologies. It is difficult to attempt a formal definition of such an evolving medium, but the basic features identified by Conklin (1987) of machine supported links between blocks of text, and some measure of interaction by the reader would represent an adequate working definition of hypertext. In the context of this chapter, hypertext is best viewed as a fragmented text form whose components can be rapidly accessed.

A graphic element must also be assumed in addition to natural language. As technological developments occur, the present hypertext-hypermedia distinction is likely to blur as 'hypertext' incorporates an ever larger graphic component of animation, simulation and video forms. A similar confusion has existed for some time in conventional printed works in that whilst the term 'text' can formally only refer to the written word, few 'textbooks' would now be considered complete without a large graphic element. In addition, the hypertext medium itself has generally been found to require an extra, graphic 'navigational' level to help the reader move about and locate information.

Linearity in text

Kommers defines hypertext as "a method for browsing through extended text bases" (1990, p 1). The basic assumption underlying 'hypertext techniques' being that large texts can be parsed into "self contained paragraphs which can be read and interpreted independently". The concerns of the developers of

hypertext systems have always been primarily focused on information retrieval rather than learning, and the computer was quickly recognised to be the ideal tool for traversing such dispersed fragments of text. The question addressed in this section is whether it is a good idea to deliberately fragment educational materials in order to make them more accessible to 'browsing' in this fashion, and the following section questions the status of browsing as a form of learning.

The myth of linearity

Hypertext is often described as being 'structured' and 'non-linear', presumably in contrast to conventional 'unstructured', 'linear' text. However it is a mistake to think of conventional texts, and particularly expository teaching texts, as being purely linear. The skilful author may use the linear text form to weave an entirely non-linear pattern of associations in the reader's mind. Text linguists such as Grimes (1975) and de Beaugrande (1980) have shown how under a superficially linear form, authors may create complex relational structures. Figure 1. shows de Beaugrande's analysis of linearity in diagrammatic form, and it can be seen to be very involved.

It could even be argued that the simple pointer and hierarchical structures provided in hypertext are semantically more limiting that the complex implicit relationships created in conventional materials. Distance teaching texts may encompass a whole academic year's worth of study, and are conceived of by their authors and readers as being 'tutorials in print' (Rowntree, 1986). These texts may properly only be described in terms of Grimes' *staging* metaphor where cycles of ideas are repeated and overlayed upon each other; for example a central theme being repeated within progressively more complex contexts.

A line of argument will almost certainly make up more than a single paragraph. To reduce the presentation of text to the paragraph, or an arbitrary small number of paragraphs, is to make it more difficult to present a coherent view. However the alternative of creating the 'electronic scroll', as has happened in many hypertext systems, is to completely defeat the ergonomic gains of rapid component access.

Designing prose

Nash discusses the idea of 'designing' prose, where "the paragraph functions as a viewfinder, freely used to define the groupings and transitions of a compositional design" (1980 ,p8). He writes of a "free and unending play of possibilities", where "the writer may frame a dominant motif spanning a number of subordinate details, or may perhaps outline a sequence of related

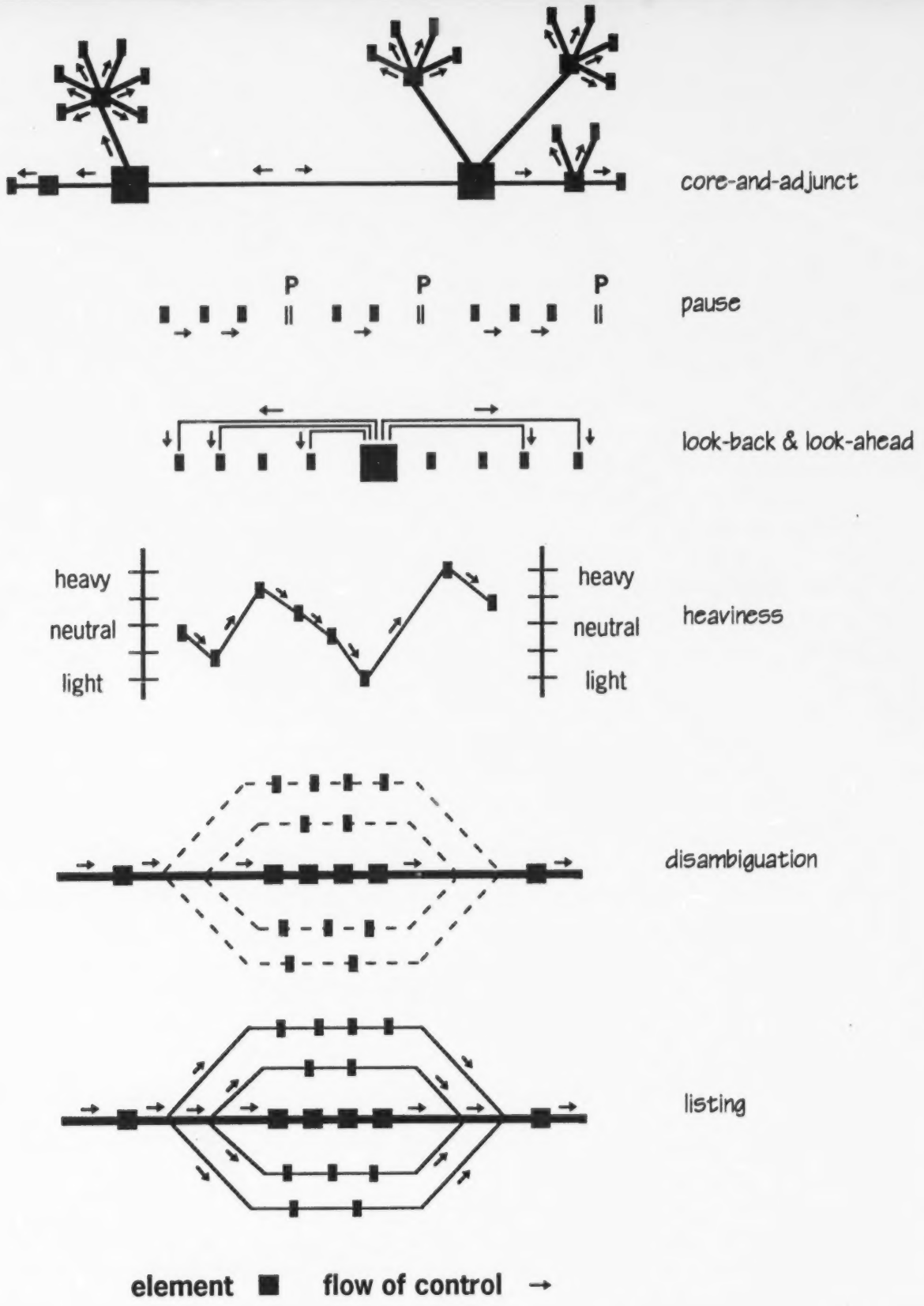

Figure 1. de Beaugrande's seven principles of linearity

(redrawn from de Beaugrande (1980)

propositions". In direct contrast to the assumption that Kommers shows to underlie hypertext, Nash writes that paragraphs should be thought of as "units in developing discourse", and that it is "a mistake to think of them as self-contained units, the 'building blocks' of text". To dispense with paragraph structure is to loose one of the most important techniques of composition available to the writer, and means that hypertext is only likely to be suited to encyclopedic or fragmented forms of knowledge. Equally when left without Nash's 'viewfinder' upon the the author's rhetorical structure, the reader may feel lost in a maze of overconnected facts.

Van Dijk (1979) has developed an analysis of the way that linguistic and graphical cues can be used to assign the relative relevance of parts of a text. Within his framework it is possible to identify several levels where hypertext can make an original contribution, but it is important to note that such explicit cues will never be the only, or necessarily the most important, forms of non-linearity and argument structuring within a text. A direct consequence of the fragmentation effect in hypertext is that it is likely to make it more difficult for the learner to perceive the author's intended argument structure— unless certain linearity constraints are imposed on the hypertext form. For example it may be necessary to impose a certain ordering of concepts until some critical point is reached.

Text types

Where text is conceived of as a 'database of facts', then hypertext obviously provides an efficient technology for their acquisition and manipulation. However where text is taken to express a "configuration of ideas" and to "represent a vehicle of purposeful interaction between the writer and the reader" (de Beaugrande & Dressler, 1981), then other criteria must apply. Nash describes the organising principles underlying the creation of discursive or expository prose as the complex operation of *expounding*,

> "There is a programme of assertions, examples, qualifications, but these are not presented as a series of distinctly labelled positions. Instead, they are related to each other in a progressive unfolding pattern, the turns and connections of which are demonstrated in various ways-" (1980, p6)

It is possible to imagine a 'dimension' of text types ranging from *text as database*, where the reader has complete control, to *text as argument*, where the author guides the reader's study. This dimension is also described by the length of cohesive reference within the text, the longer the referential links the more the author's argument controls the reader.

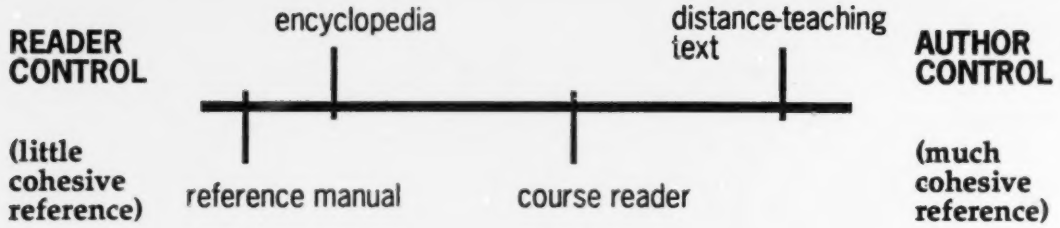

Figure 2. A dimension of text types

The amorphous 'links' provided by hypertext do not provide any true cohesive reference. If everything is related to everything then essentially no cohesion is provided. It is only by **selective** application of the reference devices that the author turns a pile of facts into something interesting, an organised text. And to the extent that the cohesive reference is selective, the text is linear.

Malleability

The conventional rhetoric for hypertext is based on the idea of subordinating linearity in that links and hierarchies become the main structural representation that is presented to the reader. Clearly any computer based text form is bound to be implemented in terms of the basic computing elements of lists and pointers. The question is whether these basic structures have to be made so dominantly apparent in their raw form. The simple use of these devices stems from the limited original concerns of the designers of hypertext systems, *ie* with information retrieval rather than learning. If it was wished to devise a rhetoric for a general computer based document intended to support learning, then the emphasis would be quite different. The most significant pedagogic feature of hypertext is its *malleability*; it may change over time and it is capable of offering multiple perspectives on a particular domain. It is possible to use hypertext to present, and then represent, ideas in ways that are difficult to achieve in print.

Examples of hypertexts based on such a learner centred rhetoric have existed for some time, but are now beginning to be more purposefully developed. Some of the ideas that are possible can be seen in an experimental hypertext devised by the author to facilitate a 'compare and contrast' exercise, Figure 3. The operation of the hypertext is based on the notion of *views* and *modes*, and the nature of the learning task is apparent in the structure of the hypertext. The sub-heading structure remains constant whilst the contrasted topics are aligned against it. Switching modes allows the same operation to be made,

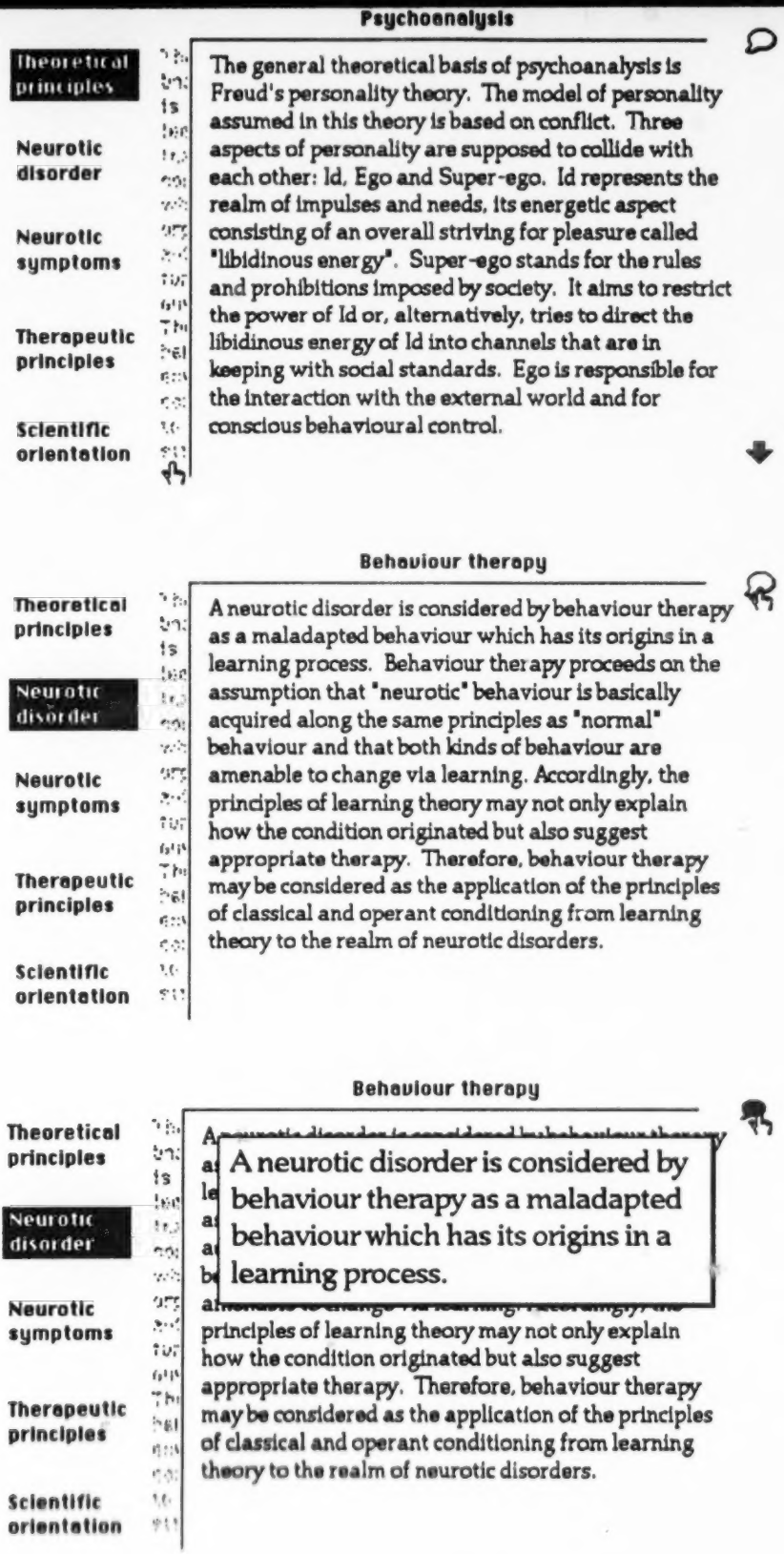
Psychoanalysis
Theoretical principles
Neurotic disorder
Neurotic symptoms
Therapeutic principles
Scientific orientation
The general theoretical basis of psychoanalysis is Freud's personality theory. The model of personality assumed in this theory is based on conflict. Three aspects of personality are supposed to collide with each other: Id, Ego and Super-ego. Id represents the realm of impulses and needs, its energetic aspect consisting of an overall striving for pleasure called "libidinous energy". Super-ego stands for the rules and prohibitions imposed by society. It aims to restrict the power of Id or, alternatively, tries to direct the libidinous energy of Id into channels that are in keeping with social standards. Ego is responsible for the interaction with the external world and for conscious behavioural control.
Clicking on the 'hidden' text causes a switch to the alternate topic.
Behaviour therapy
Theoretical principles
Neurotic disorder
Neurotic symptoms
Therapeutic principles
Scientific orientation
A neurotic disorder is considered by behaviour therapy as a maladapted behaviour which has its origins in a learning process. Behaviour therapy proceeds on the assumption that "neurotic" behaviour is basically acquired along the same principles as "normal" behaviour and that both kinds of behaviour are amenable to change via learning. Accordingly, the principles of learning theory may not only explain how the condition originated but also suggest appropriate therapy. Therefore, behaviour therapy may be considered as the application of the principles of classical and operant conditioning from learning theory to the realm of neurotic disorders.
Clicking on the bubble switches to the 'main points' overlay mode
Behaviour therapy
Theoretical principles
Neurotic disorder
Neurotic symptoms
Therapeutic principles
Scientific orientation
A neurotic disorder is considered by behaviour therapy as a maladapted behaviour which has its origins in a learning process.
principles of learning theory may not only explain how the condition originated but also suggest appropriate therapy. Therefore, behaviour therapy may be considered as the application of the principles of classical and operant conditioning from learning theory to the realm of neurotic disorders.
Clicking the bubble again switches back to the plain text mode

Figure 3. A 'compare and contrast' hypertext.

but at a higher level of abstraction. This text corpus has been widely used in experimental studies concerned with learning from prose, eg Schnotz (1982), Waller & Whalley (1987) and Mandl et al (1991), and it is important to note that the paragraphs were written, or at least rewritten, to be able to stand alone. Whilst this makes graphic and hypertext versions of the texts possible, it is quite noticeable (*cf* Nash's argument detailed earlier) that this has the effect of making them rather boring to read as prose, as there is no use of the connectives to link the ideas between paragraphs. Physical juxtaposition is one way to make conceptual relations, but it lacks the subtlety of the many linguistic devices possible.

Samarapungavan & Beishuizen (1990) describe a much larger hypertext based on similar ideas. Their system takes an introductory psychology text and allows the reader to view the content from four different *perspectives* provided by a higher level map structure. It is in developing systems such as this that the positive future for hypertext lies.

Learning from hypertext

Research studies

It is clear that for some aspects of teaching, hypertext 'works'. Landow (1990) describes a large, long-term study where whole courses are studied in a networked hypertext system shared by both readers and writers. Used in this way as an environment to promote collaborative learning, and in particular collaborative writing, hypertext provides a powerful tool. However as Landow points out, this is a special situation where "it is not important that readers may retain less information that they encounter whilst reading text from a screen rather from print". Studies with other goals have had far less positive results.

Kommers describes several long term studies made with large, very carefully constructed hypertexts. His results were uniformly bad in terms of using hypertext as a medium to improve learning, and particularly so for the less able pupils. His logged interaction data shows how browsing can easily become an activity where students can 'fail to see the wood for the trees'. Kommers writes that,

> "students need extra guidance before they know how to utilize hypertext facilities. The data retrieval and data modification tools used without guidance are too open to be effective while studying in the traditional school context." (1990, p203)

Whilst Samarapungavan & Beishuizen (1990) using their multiple perspective hypertext found no difference in the amount of factual knowledge learnt by students using their system, they did find evidence in terms of higher level 'reasoning' questions. Interestingly though, they note that the improved learning may not be due to linear versus non-linear aspects of their text *per se*, but might result from additional information in the graphically organised 'map' provided as an access structure in the non-linear condition. Such high level abstractions are always going to be in danger of 'spoon-feeding' students with structures that they should be developing for themselves over the period of the course.

Mandl *et al* (1991) report on a study using a different hypertext version of the 'compare & contrast' texts described earlier. Again their results showed that hypertext presentation favoured the most able students, which is directly contrary to the expectations and hopes of the early hypertext developers. Unless the entertainment/motivation factor for hypertext can be made sufficiently large enough to compensate, it would seem unwise to inflict it on less able readers.

General issues

Reflective critical reading requires the student to alternately suspend and then make judgments concerning the author's argument, and linear texts contain 'turn-taking' cues to encourage such activities. As has already been pointed out, a consequence of the fragmentation effect in hypertext is that it is likely to make it more difficult for the learner to perceive the author's intended argument structure, and consequently must make it more difficult to organise hypertext materials to support higher level learning.

The most natural mode of study with hypertext would appear to be that of *browsing*. For information retrieval and certain aspects of learning this is an entirely appropriate study strategy. However many educators would consider the browsing activity to be ill-suited to the courses that they wish to create, and the forms of learning that they wish to encourage. Where an author is trying to develop ideas within a particular context or framework, or where the student is being required to develop a deeper understanding, then browsing is likely to be inappropriate.

Writers of distance teaching materials have always had to concern themselves with the problem of the 'over organised' text. When attempting to create a complete 'tutorial-in-print', there is always the danger of pushing the student into a passive role, and leaving them no room to think for themselves. A similar problem exists for writers of

hypertexts. The author has noted elsewhere that,

> "the *artefacts* introduced by the hypertext form, in order to improve *accessibility*, mitigate against its use as the principal teaching medium. The solutions to the problems of *navigation* and *orientation* within the hypertext genre will involve **providing** the very same high level structures that many educators would wish their students to be **creating** for themselves as active independent learners". (Whalley, 1990, p65)

It is necessary in the design of hypertext systems to devise structures that do not just hand over to the student a spurious form of 'control'. Difficulties arise in devising hypertext structures suited to browsing that will also facilitate and encourage deeper processing. The most successful uses of hypertext will involve the learner and lead them to adopt the most appropriate learning strategy for their task. They will provide guidance and encouragement to students to make more than a surface level pass through the material, and to develop higher level learning skills.

A synthesis

Is it possible to have a synthesis between the desirable features of non-linear hypertext and linear prose? It is worth noting that one of the original hypertext systems, *Guide*, allows the author to implement a form of 'folding' and 'unfolding' of paragraphs, as well as giving direct reference structures within the text. It is perhaps only when attempting to develop a text using such systems, that the author can most clearly feel the tension between gains in accessibility and retrieval efficiency at the expense of losing continuity of exposition.

A solution to this problem is to move away from the idea of 'free standing' paragraphs that appear and disappear, and to have the actual content of the text changing with the degree of folding or unfolding. This would be to have an additional intermediate level of folding where summaries stood for sections of text, rather than immediately collapsing to the heading structure. This form of hypertext could unfortunately only be achieved with greatly increased authoring effort, although the compromise of only having additional 'overview' and 'summary' levels replacing larger blocks of text might be sufficient. Where the attempt is made to directly 'port across' text written for dissemination by conventional print to a hypertext format, the appropriate use of these components is likely to be crucial to its success.

The *animateur*

In the context of the provision of distance teaching, the role of the course tutor has sometimes been described as that of an *animateur*; bringing the course to life for the home based student. Some concerned with the role of the tutor would argue that they have a far more independent role than simply to act as an 'agent' for the text author. However, ignoring the claims of AI, this title fits quite aptly the tasks most appropriate to the hypertext and multi-media aspects of course materials: presenting alternative 'views' to the student; efficient fact finding ; interactive animation of diagrams and simulations ; providing activities etc. It is possible to conceive of this more prosaic, but realistic, role for the hypermedia within the general context of a *computer based document*, encompassing linear prose, non-linear hypertext and the other 'multi-media' devices.

The use of the hypermedia in this supplementary role is likely to lead to an increase rather than a decrease in their perceived worth. The ability of such documents to reflect the author's prior expectation of the changing needs of the reader is educationally quite significant, and the equivalent devices in conventional print tend to be both rather clumsy and also expensive to produce. The importance of 'activities' in distance teaching texts has long been recognised (Rowntree, 1986). They are seen as a vital feature to keep the learner engaged, to come up with their own ideas, and to not perceive their task as being merely to memorise facts.

Given that significant ergonomic and economic problems are overcome, it is conceivable that such a general media form might eventually supplant conventional print. However for the present it is appears that the computer based dynamic and interactive elements of printed course materials can best be thought of in the supplementary role of *animateur* for the distant author.

Conclusion

The adoption of such a conceptually simple technology as hypertext is unlikely to have as much pedagogic impact as was originally claimed. Non-linear hypertext is obviously a good way to package information for efficient information retrieval and is useful for some forms of interactivity. However because of its fragmented nature, it is not a suitable medium to form the core of teaching materials. A learner centred rhetoric is possible for hypertext based on its most important pedagogic feature, *malleability*, and its use in a supplementary role within the context of a more general document form offers considerable potential for education.

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Programme on Learner Use of Media

This paper is included in the Programme's

ANNOTATED BIBLIOGRAPHY OF EDUCATIONAL MEDIA

which is available on-line from the IET server.
Printed copies, or copies on computer discs of various formats are available from Hansa Solanki in IET (ext: 2909)

The bibliography with abstracts is large (almost 300 items). The following is the list of contents showing the sections under which papers have been organised. You may order either the whole bibliography or a selection of individual sections.

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  - (1b) Use of Video vs Broadcast
    - (i) Broadcast and Video Access Backup Schemes
  - (1c) Radio
  - (1d) Cable and Satellite
  - (1e) European Policy
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